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I. *Some Remarks on a late Essay of Mr. Cassini, wherein he proposes to find, by Observation, the Parallax and Magnitude of Sirius.* By Edmund Halley, LL.D. R. S. S.

IN the *Memoires* of the *Royal Academie* of *Paris*, for the Year 1717. but now very lately published, there is one very remarkable Essay, by Mr. *Cassini*, concerning the *Annual Parallax* of the *Fix'd Stars*, and particularly of *Sirius*; and in conclusion, he determines the Diameter of *Sirius* to be as much bigger than that of the *Sun*, as the *Sun's* is greater than that of the *Earth*, which he supposes to be 100 times: And the distance from the *Sun* to the *Earth* being certainly about 100 Diameters of the *Sun*, it will follow, that the Globe of *Sirius* must be a Sphere, whose Diameter must equal the distance between the *Earth* and *Sun*.

To prove this, he tells us that he made use of an excellent Telescope of 34 *French Feet*, or 36 *English*, leaving an Aperture of but an Inch and half, to take off the spurious Rays of the *Star*, which then appeared round, and sufficiently well defined; and comparing his Body to that of *Jupiter*, which he says, was then 50 Seconds Diameter, he found that the Diameter of *Jupiter* was ten times greater than that of the *Star*, which by consequence was seen under an Angle of about 5 Seconds; which is his first Position.

Then he tells us, that to make the Observations of the Parallax of this *Star* with all the exactness possible, he employed a Telescope of three Foot, in a Copper
A Tube,

Tube, having fixed in the common *Focus* of the two Glasses, four threads crossing one another in the Center, under Angles of 45 Degrees. This Tube he firmly fix'd to the Plain of a *Mural Arch*, which had been for above 30 Years immoveably cemented to the Wall of the *Royal Observatory*, to which he chose to fix it, because of the great Solidity thereof, and its being therefore the less liable to shake; and that after having stood 30 Years, there was no fear of its settling any further in the space of one Year; besides, that it was easy to perceive if any such alteration should happen to it.

Having therefore fix'd his three Foot Tube as above, so that, about the beginning of *April*, 1714. *New Style*, (I suppose, because then *Sirius* was in *Square* to the *Sun*) the Star being exactly in the *Meridian*, past over the Center of the Tube, he observed that on the 20th of *April* the Star touched the Horizontal Thread with its under edge, being apparently all above it, in the inverting Tube, but really below. On the 15th of *May*, and 6th of *June*, it past again by the Center. On *June* the 27th it appeared a little under, and on *July* the 9th it was found to touch the under part of the Thread. On *October* the 5th it again past by the Center; but on *December* the 29th, it touched the upper part of the Thread. *January* the 18th, 1715. being the coldest Day of that Winter, it past exactly by the Center; and on the 27th of *March*, and the 1st of *April*, it almost touched the upper side of the Horizontal Thread, from which it seem'd a little separated. But on *June* the 7th, it past a little under the Center; and on *June* the 29th, the *Sun* being then in conjunction with *Sirius*, it past under the Thread, so as to touch it with its upper edge. Whence it appears, that in the space of the whole Year, there had been no other variation of the *Meridian* Altitude of *Sirius*, than the breadth of the Thread, which
appear'd

appear'd equal to the Diameter of the Star, which he takes to be five, or at most six Seconds.

Supposing this to be so, he then shews that the whole Diameter of the annual Orb is to the distance of *Sirius*, as the Sine of $6''$ to the Sine of $39^{\circ} 33'$ the Latitude of the Star, whence the aforesaid immense magnitude of the Body thereof, is a necessary Consequence.

But before this obtain a full assent, it may not perhaps be amiss to enquire whether the suppos'd visible Diameter of *Sirius*, were not an Optick Fallacy, occasioned by the great contraction of the *Aperture* of the *Object Glafs*: For we all know that the Diameters of *Aldebaran* and *Spica Virginis*, are so small, that when they happen to immerge on the dark Limb of the *Moon*, they are so far from loosing their Light gradually, as they must do were they of any sensible magnitude, that they vanish at once with their utmost Lustre; and emerge likewise in a Moment, not small at first, but at once appear with their full Light, even tho' the Emergion happen very near the *Cusp*; where, if they were four Seconds in Diameter, they would be many Seconds of Time in getting entirely separated from the Limb. But the contrary appears to all those, that have observed the Occultations of these bright Stars. And tho' *Sirius* be bigger than either of them, yet he is by far less than two of them; and consequently his Diameter to theirs is less than the Square Root of 2 to 1, or than 1.4 to 10; whence, in Mr. *Cassini's* excellent 36 Foot Glafs, those Stars ought to be about four Seconds in Diameter; and they would undoubtedly appear so, if view'd after the same manner; whereas we are *aliunde* certain, that they are less than one single Second in Diameter. The great strength of their native Light, forming the resemblance of a Body, when it is nothing else but the spissitude of their Rays.

As to the other part of the Argument, that the alteration of the declination of *Sirius*, on the score of the access of the Earth in *December*, and its recess in *June*, amounts to 6 Seconds; I can only remark, that, besides that a *Radius* of 3 Feet, as it seems that made use of was no more, is somewhat too small for so extremely nice an Observation, 6" being subtended by the $\frac{1}{1700}$ part of an Inch, some of the Observations before recited do plainly shew, that the *Refraction* of the *Medium* did intermix with those Differences that might be occasioned by the *Parallax*.

But the principal Objection against the Conclusion of this Argument, seems to be, that the Meridian altitude of *Sirius* at *Paris* being under 25 Degrees, the ordinary Refraction of the Star is 1' 55" or 115 Seconds; and the Barometer rising and falling above two Inches in Thirty, shews that the *density* of the *Air*, on that score, may be a 15th part more at one time than another. Whence the Refractions being always proportional to the *density* of the *Medium*, as we have all seen it often demonstrated by Mr. *Hanksbee*, both in *Vacuo*, and in a *scarcely* and *treble condensed Air*, it is plain that in that Altitude the Refraction of a Star may differ about 7 or 8 Seconds, or the 15th part of 115", which is more than the whole *Parallax* supposed to have been observed.

It were to be wish'd that Mr. *Cassini* would please to try this Matter by the *Lucida Lyra*, instead of *Sirius*, which, tho' somewhat less than him, is as near to the *Softital Colure*, and has much greater Latitude, being but 28 *grad.* from the *Pole* of the *Ecliptick*, whence its *Parallax* would be so much greater; and being at *Paris* within 10 *grad.* of the *Zenith*, the grand Objection of the difference of Refraction, would be almost wholly removed.